

### **Remarks/Arguments**

This paper accompanies a Request for Continued Examination filed in response to the final Office Action of October 24, 2008. In the final Office Action, the Examiner rejected all claims 17-30. For the following reasons, reconsideration is respectfully requested.

#### **Section 103(a) rejections:**

Claims 17-30 were rejected under 35 USC §103(a) as being unpatentable over Becker et al (DE 199 11910 A1) in view of De Wet et al (WO 02/31085 A2).

As amended, independent claim 17 is directed to a process for extracting oxygenates from a hydrocarbon stream containing a range of hydrocarbons in the C<sub>8</sub> to C<sub>16</sub> range. The process includes a liquid-liquid extraction step of contacting the hydrocarbon stream with a solvent comprising a mixture of methanol and water to extract the oxygenates from the hydrocarbon stream. An extract from the liquid-liquid extraction step is sent to a solvent recovery column in which the methanol does not form an azeotrope, and from which a tops product comprising methanol, olefins and paraffins is recycled to the liquid-liquid extraction step, thereby enhancing the overall recovery of olefins and paraffins.

With reference to Figure 3, the Becker reference discloses a process for removing oxygenates from a hydrocarbons stream 1 having 6 carbon atoms (e.g., 1-octenes) by contacting the hydrocarbon stream with a solvent comprising water and an alcohol in a liquid-liquid extracting distillation column 3 to produce an extraction stream 8 which is sent to a solvent recovery column 9. It is noted that a hydrocarbon product stream and a solvent stream 12 are recovered from the solvent recovery column and that the solvent stream 2 is then recycled back to the extraction distillation column 3.

The Applicants, however, point out the following:

- 1) As noted by the Examiner, the Becker reference does not teach the hydrocarbon stream containing a range of hydrocarbons in the C<sub>8</sub> to C<sub>16</sub> range.
- 2) The Becker reference, at page 2 paragraph 5, provides that the alcohol in the solvent may be selected from a group of alcohols: methanol,

ethanol, propanol and butanol. However, only ethanol is mentioned in the process described with reference to Figure 3.

3) In Becker, the solvent recovery column 9 is an **azeotropic** distillation solvent recovery column, from which the oxygenates exit the bottom and the water/ethanol/hydrocarbons azeotrope are distilled overhead as a vapor. The distillate must be fed to a decanter 16 in which the hydrocarbons are phase-separated from the ethanol/water solvent which is returned to the liquid-liquid extracting distillation column 3.

4) Becker, at paragraphs 4-5 of page 2 and at the last paragraph of page 6, shows that ethanol can be used successfully for the liquid-liquid extraction of oxygenates from a hydrocarbon stream having 6 carbon atoms with the subsequent recovery of the solvent in solvent recovery column using azeotropic distillation column where the ethanol forms an azeotrope. There is no teaching or suggestion in Becker that the solvent recovery step could be replaced with a temperature distillation column in which there is no azeotrope.

In the process of the present invention, the bottoms of liquid-liquid extraction separation is not fed to an azeotropic distillation column for solvent recovery, but to a temperature distillation (under conditions where the methanol does not form an azeotrope) instead, in which less (if at all) water is distilled (boiled) overhead as a vapor, since methanol does not azeotrope with water.

In order to further distinguish claim 17 over Becker, claim 17 has been amended to make it clear that under the conditions of the inventive process, methanol does not form an azeotrope in the solvent recovery column, i.e. a temperature distillation is used in the solvent recovery column, as opposed to the azeotropic solvent recovery distillation step taught by Becker.

Using a temperature distillation for the solvent recovery (i.e. where the methanol does not form an azeotrope) is not an obvious replacement of the azeotropic distillation step taught by Becker. As stated in an earlier response, the feedstock of the present invention contains a mixture of hydrocarbons and oxygenates having from 8 to 16 carbon atoms. The boiling point of C10 hydrocarbons would overlap with that of C8 alcohols, as would C14 hydrocarbons with C12 alcohols. As a result, the skilled person would have expected that the

hydrocarbons would report to the bottoms of the temperature distillation with the oxygenates, and therefore be lost, due to its expected azeotrope with oxygenates. However, it has most unexpectedly been found that methanol causes an extractive distillation effect in that the volatility of hydrocarbons is increased relative to that of oxygenates, allowing for recovery of significant quantities (up to 60% - see page 8 line 27) of hydrocarbons with methanol as overheads, which is recovered by recycling to the of liquid-liquid extraction step. The skilled person would therefore not have considered temperature distillation for fear of loss of hydrocarbons. This extractive distillation effect is not suggested by Becker or De Wet, nor can it be since these references suggest a different technology approach - azeotropic distillation. In De Wet, hydrocarbons report to the bottom of the solvent recovery column and are lost.

Even if one assumes that methanol is an obvious replacement for ethanol (which it is not), a further consideration of the implications of these replacements in the Becker process is required:

The first implication would be that azeotropic distillation solvent recovery column 9 would not work as methanol/water would not form an azeotrope with the heavier hydrocarbons of the feedstock of the present invention.

The second implication relates to the feedstock of the present invention which, as stated, is a mixture of hydrocarbons having chain lengths from 8 to 16 carbon atoms and oxygenates. Should this feedstock be fed to the Becker process, the of liquid-liquid extraction bottoms comprising water/C8-C16 hydrocarbon/methanol (substituted) will be separated by temperature distillation (substituted) into a raffinate (of heavy [C12-C16] hydrocarbons, water and oxygenates) and distillate (of light [C8-C11] hydrocarbons and methanol). This would result in a lower concentration (about 50%) of the hydrocarbons reporting to the distillate and a corresponding increase in the solvent to hydrocarbon ratio in the decanter. This in turn would result in a high water to hydrocarbon ratio, as a result of which the decanter 16 will not be effective in achieving phase separation between the methanol/water and hydrocarbons.

The De Wet process on the other hand places great emphasis on keeping the amount of water in the solvent below the azeotropic ratio (between water and

acetonitrile). The reason for this is that there are some oxygenates in the feed that form azeotropes with water, so if the water is not drawn overhead by the binary azeotrope in the solvent recovery column, it will azeotrope some of the oxygenates into the overhead. Since the overhead stream goes back to the top of the extraction column, no oxygenates can be tolerated in this stream.

In addition to the foregoing, it is also significant to note that the temperature distillation in the solvent recovery column of the present invention results in a more energy effective process than Becker, as less heat is required to boil water.

It is therefore submitted that only with hindsight reasoning would one of ordinary skill in the art come to make a three-directional modification of:

using the process on a feedstock having a range of hydrocarbons in the C8-C16 range;

selecting methanol as the solvent; and

using temperature distillation in the solvent recovery column where the methanol does not form an azeotrope;

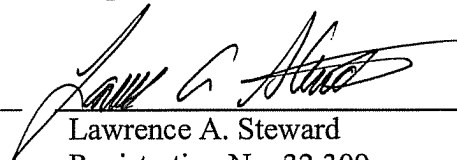
and thereby attain the benefit of hydrocarbon recovery.

**Conclusion:**

Based on the foregoing, Applicants respectfully submit that the present invention, as claimed herein is novel and inventive in view of Becker and/or De Wet. Accordingly, Applicants respectfully request the issuance of a Notice of Allowance. If the Examiner believes that prosecution of this application can be advanced by way of a telephone conversation, the Examiner is invited to telephone the undersigned attorney.

Respectfully submitted,

Dated: March 23, 2009



Lawrence A. Steward  
Registration No. 32,309  
Attorney for Applicant(s)

BRINKS HOFER GILSON & LIONE  
CUSTOMER NO. 27879  
317-636-0886